Enhanced Water Quality Monitoring and Modeling Program for the A.R.M. Loxahatchee National Wildlife Refuge Quarterly Update Report – June 2015

Prepared by:
Donatto Surratt, A.R.M. Loxahatchee National Wildlife Refuge

Overview

This update is a summary of activities since the previous status report of March 2015 on the implementation of the Refuge's Enhanced Water Quality Monitoring and Modeling Program. A project overview, and other detailed information about the program can be found at: http://sofia.usgs.gov/lox_monitor_model/. The primary objective of this overall program (Brandt et al. 2004) focuses on providing information for use in ecological management of the Refuge (e.g., USFWS 2007a, b; USFWS 2009; USFWS 2010a, b; USFWS 2012a; USFWS 2012b; USFWS 2013; USFWS 2014; USFWS 2015).

The Refuge's monitoring component of this program also addresses one of the Consent Decree Principals recommendations (17 December 2003):

> ***B. Enhancing Monitoring of the Refuge***
> *Design and implement an enhanced monitoring program to improve spatial and temporal understanding of factors related to phosphorus dynamics.*

Information Availability

Through collaboration with USGS, information from the Refuge's Enhanced Water Quality Monitoring and Modeling Program has been made available on the USGS' SOFIA web site at: http://sofia.usgs.gov/lox_monitor_model/.

Final data for monthly samples through May 2006 are publicly posted on DBHYDRO by the SFWMD at http://my.sfwmd.gov/dbhydroplsql/show_dbkey_info.main_page. Data for June 2006-June 2015 are posted on the Technical Oversight Committee's web site at http://www.sfwmd.gov/toc/. This report includes information from samples collected through June 2015.

Water Quality Data Analyses Update

Primary efforts for this quarter involved exploring mechanisms to continue translating information from the program to aid in Refuge management decisions, and working on the program's Annual Report.

Monitoring Update (April – June 2015)

Sampling of the enhanced water quality monitoring network (**Figure 1**) occurred at 28 stations in April, 14 in May, and 10 in June 2015 (**Table 1**).

Total phosphorus data available to date for July 2014 through June 2015 are presented in **Table 1**. Maps of stations where samples were collected for the months from April through June 2015 are presented in **Figures 2-4**.

Conductivity sonde deployment information for July 2014 through June 2015 is presented in **Table 2**.

Next Steps

The next steps for this program include additional efforts on the Annual Report, and additional model development and application.

References

Brandt, L.A., Harwell, M., Waldon, M. (2004) Work Plan: Water Quality Monitoring and Modeling for the A.R.M. Loxahatchee National Wildlife Refuge: 2004-2006. Prepared for the A.R.M. Loxahatchee National Wildlife Refuge. April, 2004. 33 pp.

USFWS. (2007a) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Monitoring and Modeling Program – 2nd Annual Report – February 2007. LOXA06-008, U.S. Fish and Wildlife Service, Boynton Beach, FL. 183 pp.

USFWS. (2007b) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 3rd Annual Report – October 2007. LOXA07-005, U.S. Fish and Wildlife Service, Boynton Beach, FL. 116 pp.

USFWS. (2009) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 4th Annual Report – July 2009. LOXA09-007, U.S. Fish and Wildlife Service, Boynton Beach, FL. 106 pp.

USFWS. (2010a) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 5th Annual Report – September 2010. LOXA08-007, U.S. Fish and Wildlife Service, Boynton Beach, FL. 43 pp.

USFWS. (2010b) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 6th Annual Report – October 2010. LOXA09-011, U.S. Fish and Wildlife Service, Boynton Beach, FL. 42 pp.

USFWS. (2012a) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 7th Annual Report – February 2012. LOXA12-001, U.S. Fish and Wildlife Service, Boynton Beach, FL. 115 pp.

USFWS. (2012b) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 8th Annual Report – October 2012. LOXA12-004, U.S. Fish and Wildlife Service, Boynton Beach, FL. 68 pp.

USFWS. (2013) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 9th Annual Report – June 2013. LOXA13-001, U.S. Fish and Wildlife Service, Boynton Beach, FL. 71 pp.

USFWS (2014) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Program – 10th Annual Report for calendar year 2013 – June 2014. LOXA14-002, U.S. Fish and Wildlife Service, Boynton Beach, FL. 71 pp.

USFWS (2015) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality

Program – 11th Annual Report for calendar year 2014 – June 2015. LOXA15-002, U.S. Fish and Wildlife Service, Boynton Beach, FL. 71 pp.

Table 1. Total phosphorus data (ppb) available for July 2014 – June 2015 from the Enhanced Water Quality Monitoring Program for: (a) marsh, and (b) canal stations for the A.R.M. Loxahatchee National Wildlife Refuge. Graphical representation of station locations are shown in Figure 1.

a) Marsh stations

Marsh Station	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15
LOXA101	17	17	24	13	11	12	18	5	16	-	-	-
LOXA102	-	10	10	8	7	7	15	4	9	-	-	-
LOXA103	-	8	10	8	6	6	12	2	9	-	-	-
LOXA105	17	15	20	15	8	10	18	5	U	6	-	-
LOXA106	-	9	9	12	7	7	16	5	7	-	-	-
LOXA107	-	8	11	10	6	-	13	2	-	-	-	-
LOXA108	-	5	10	7	6	7	12	4	9	-	-	-
LOXA109	9	8	10	5	4	6	10	11	10	6	-	-
LOXA110	6	7	11	4	4	6	8	8	3	5	-	-
LOXA111	7	8	11	11	3	5	9	6	6	-	-	-
LOXA112	6	6	10	7	5	6	11	11	7	5	-	-
LOXA113	5	7	7	8	3	5	9	6	8	7	-	-
LOXA114	6	9	8	10	4	8	9	8	8	8	12	13
LOXA117	16	15	20	19	11	14	12	11	13	9	-	-
LOXA118	7	7	10	10	3	5	U	8	11	13	-	-
LOXA119	8	9	9	4	4	5	U	8	10	5	15	-
LOXA120	5	5	8	5	5	5	U	6	11	6	16	23
LOXA122	11	13	18	14	10	16	10	14	13	12	-	-
LOXA124	9	17	13	17	13	10	13	12	17	-	-	-
LOXA126	6	6	9	9	4	6	U	4	7	U	15	-
LOXA127	7	6	9	6	3	5	U	6	9	5	9	-
LOXA128	5	6	9	12	5	6	8	7	8	5	-	-
LOXA130	10	14	15	14	9	10	13	8	8	69	13	25
LOXA131	9	7	13	7	2	5	7	U	5	8	6	13
LOXA133	23	30	28	20	20	13	23	10	18	12	-	-
LOXA134	11	14	10	14	9	12	11	6	10	8	10	-
LOXA136	15	28	27	25	14	9	32	17	15	61	-	-
LOXA137	14	13	16	12	9	7	12	12	8	6	-	-
LOXA138	9	8	10	7	U	7	10	4	9	16	-	-
LOXA139	10	9	8	8	5	7	7	7	11	12	-	-
LOXA140	12	15	25	10	11	9	13	6	U	-	-	-
LOXA141	10	11	14	10	3	8	90	15	14	9	42	17
MAX	23	30	28	25	20	16	90	17	18	69	42	25
MIN	5	5	7	4	2	5	7	2	3	5	6	13

U indicates that compound was analyzed, but the concentration was below the minimum detection limit.

Table 1 cont.

b) Canal stations

Canal Station	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15
LOXA104	23	21	20	19	21	16	22	14	26	25	26	18
LOXA115	26	20	20	19	21	17	21	12	25	18	20	22
LOXA129	39	26	25	22	23	15	24	14	23	18	23	20
LOXA132	39	26	26	25	24	12	21	13	31	20	22	24
LOXA135	24	24	24	30	21	15	31	17	26	20	18	21
MAX	39	26	26	30	24	17	31	17	31	25	26	24
MIN	23	20	20	19	21	12	21	12	23	18	18	18

U indicates that compound was analyzed, but the concentration was below the minimum detection limit.

Table 2. July 2014 – June 2015 conductivity sonde deployment information, separated by transect, for the A.R.M. Loxahatchee National Wildlife Refuge. X = data collected from sonde deployment during that month. Graphical representation of station locations are shown in Figure 1.

	2014						2015					
Site ID	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
LOXA104	X	X	X	X	X	X	X	X	X		X	
LOXA105		X		X		X	X		X		X	
LOXA106		X		X		X	X		X		X	
LOXA107		X		X		X	X		X		X	
LOXA108		X		X		X	X		X		X	
LOXA115	X	X	X	X	X		X	X	X	X	X	
LOXA116		X		X		X		X	X		X	
LOXA117		X		X		X		X	X		X	
LOXA118		X		X		X		X	X		X	
LOXA119		X		X		X		X	X		X	
LOXA120		X		X		X		X	X		X	
LOXA129	X	X	X	X	X	X	X	X	X	X	X	
LOXA130		X		X		X	X		X			X
LOXA131		X		X		X	X		X			X
LOXA132	X	X	X	X	X	X	X	X	X	X	X	
LOXA133			X	X		X	X		X			X
LOXA135	X	X	X	X	X		X	X	X	X	X	
LOXA136		X		X		X	X		X			X
LOXA137		X		X		X	X		X			X
LOXA138		X		X		X	X		X			X
LOXA139		X		X		X	X		X			X
LOXA142	X	X	X	X	X	X	X	X	X	X	X	
LOXA143	X		X		X	X		X		X		
LOXA144	X		X		X	X		X		X		
LOXA145	X		X		X	X		X		X		
LOXA146	X		X		X	X		X		X		
LOXA147	X	X	X	X	X	X		X	X	X	X	X
LOXA148	X		X		X	X		X		X		X
LOXA149	X		X		X	X		X		X		X
LOXA150	X		X		X	X		X		X		X
LOXA151	X	X	X	X	X	X	X	X	X	X	X	
LOXA152	X	X	X	X	X	X	X	X	X	X	X	
LOXA153	X	X	X	X	X	X	X	X	X	X	X	
I-8C	X	X	X	X	X	X	X	X	X	X	X	X
LOX04		X		X		X	X		X			X
LOX15	X		X	X	X	X		X		X		X

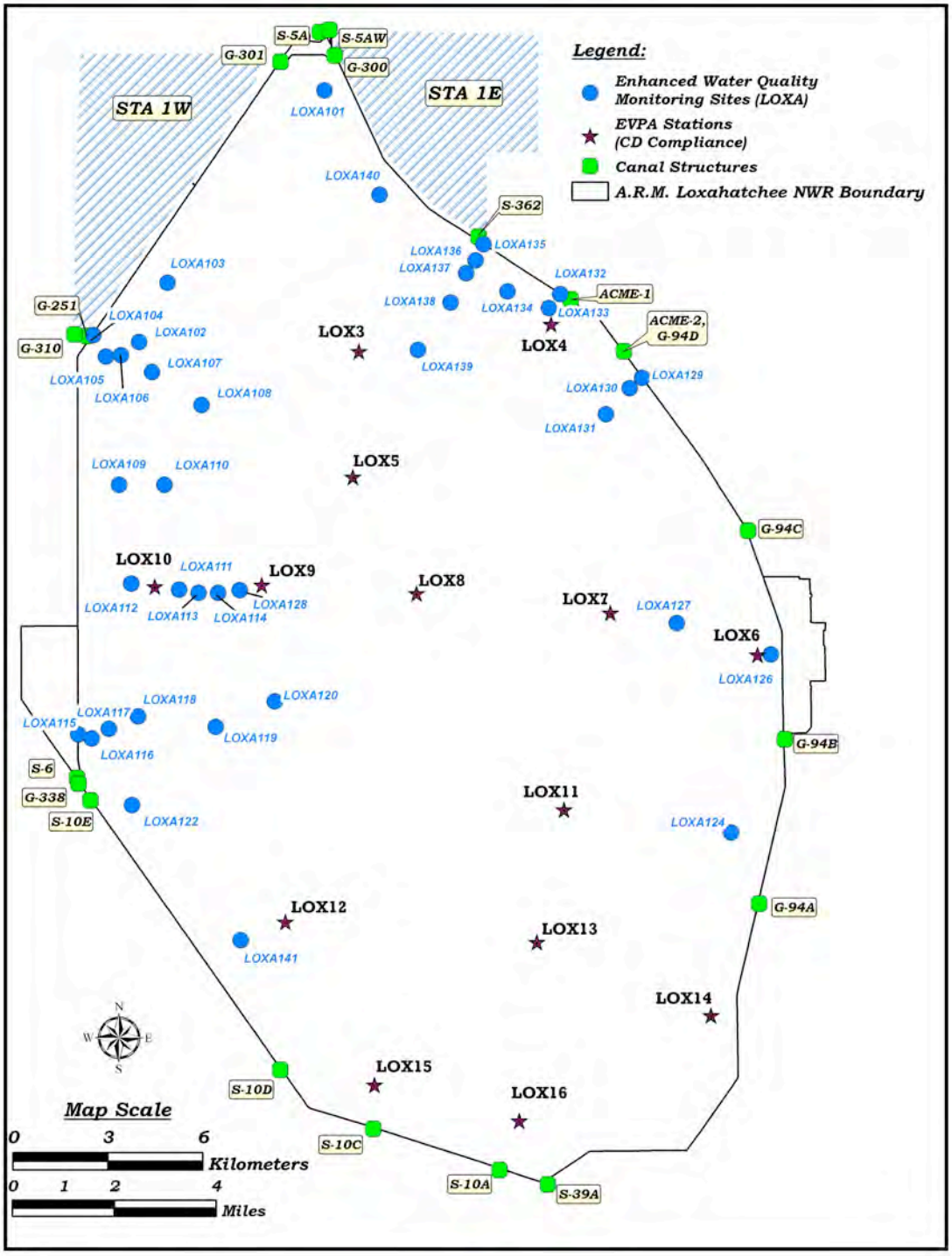

Figure 1. Location of Enhanced Water Quality Monitoring network stations (LOXA###), in relation to Consent Decree compliance stations (LOX##), for the A.R.M. Loxahatchee National Wildlife Refuge.

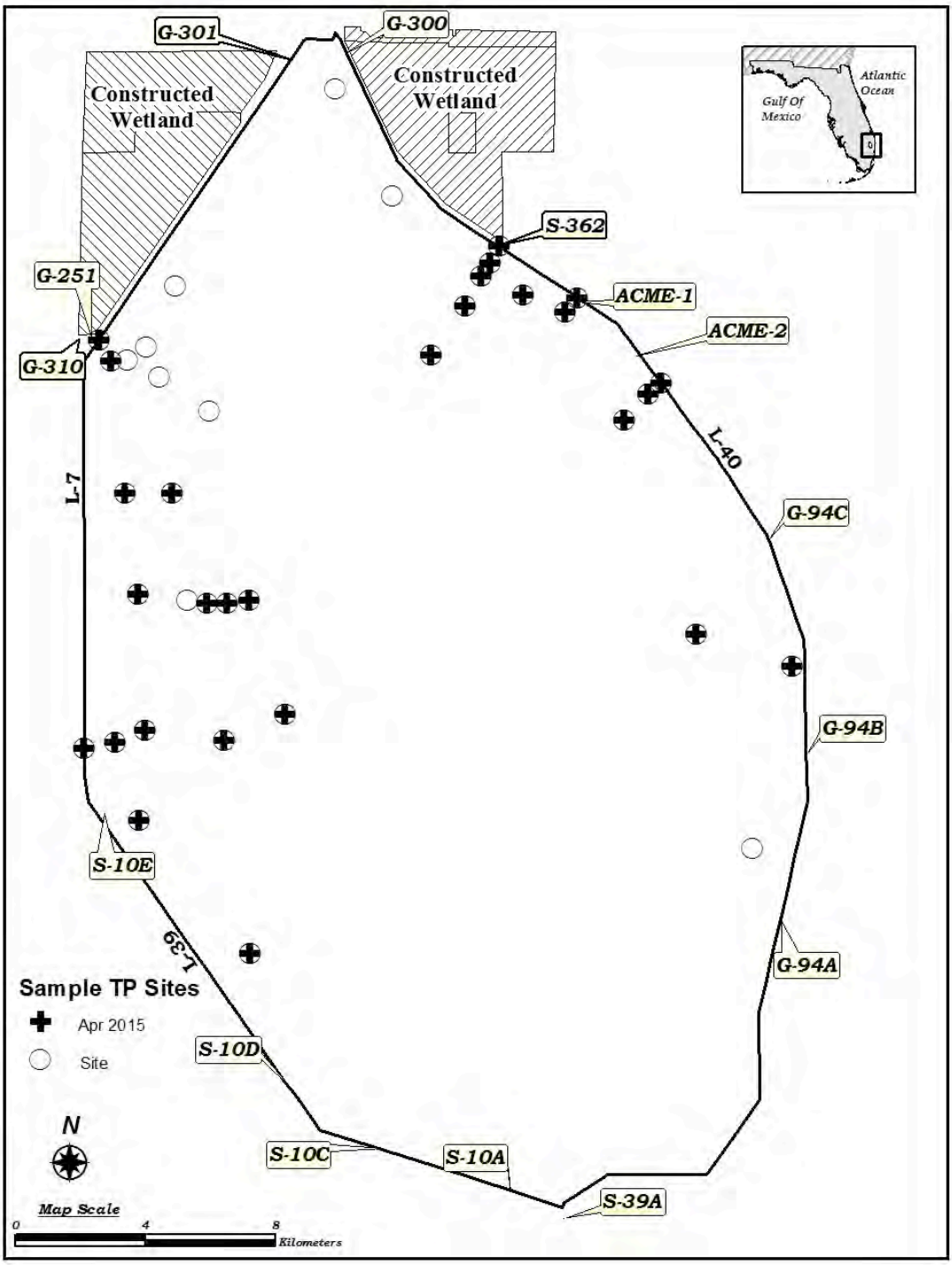

Figure 2. April 2015 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.

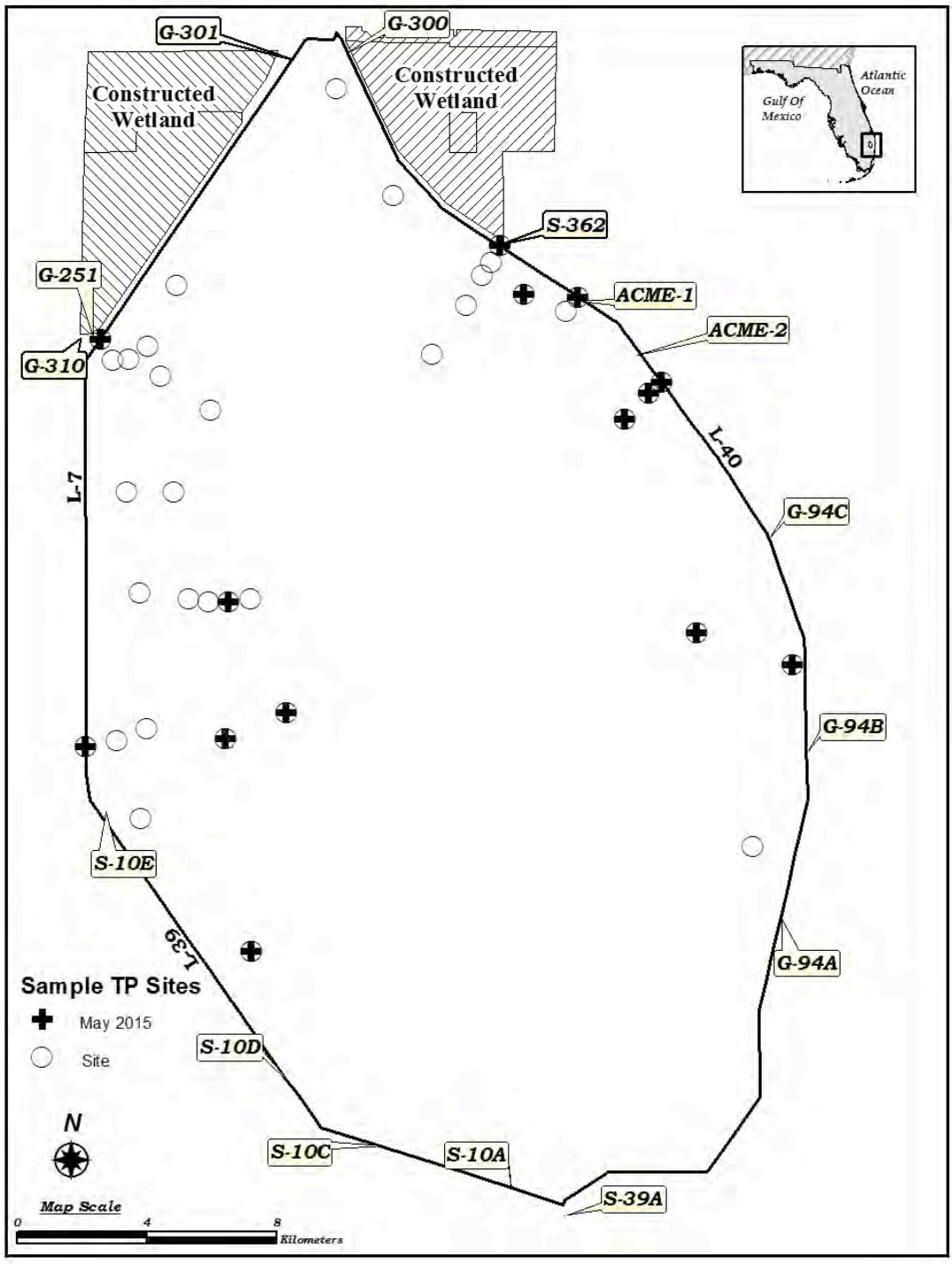

Figure 3. May 2015 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.

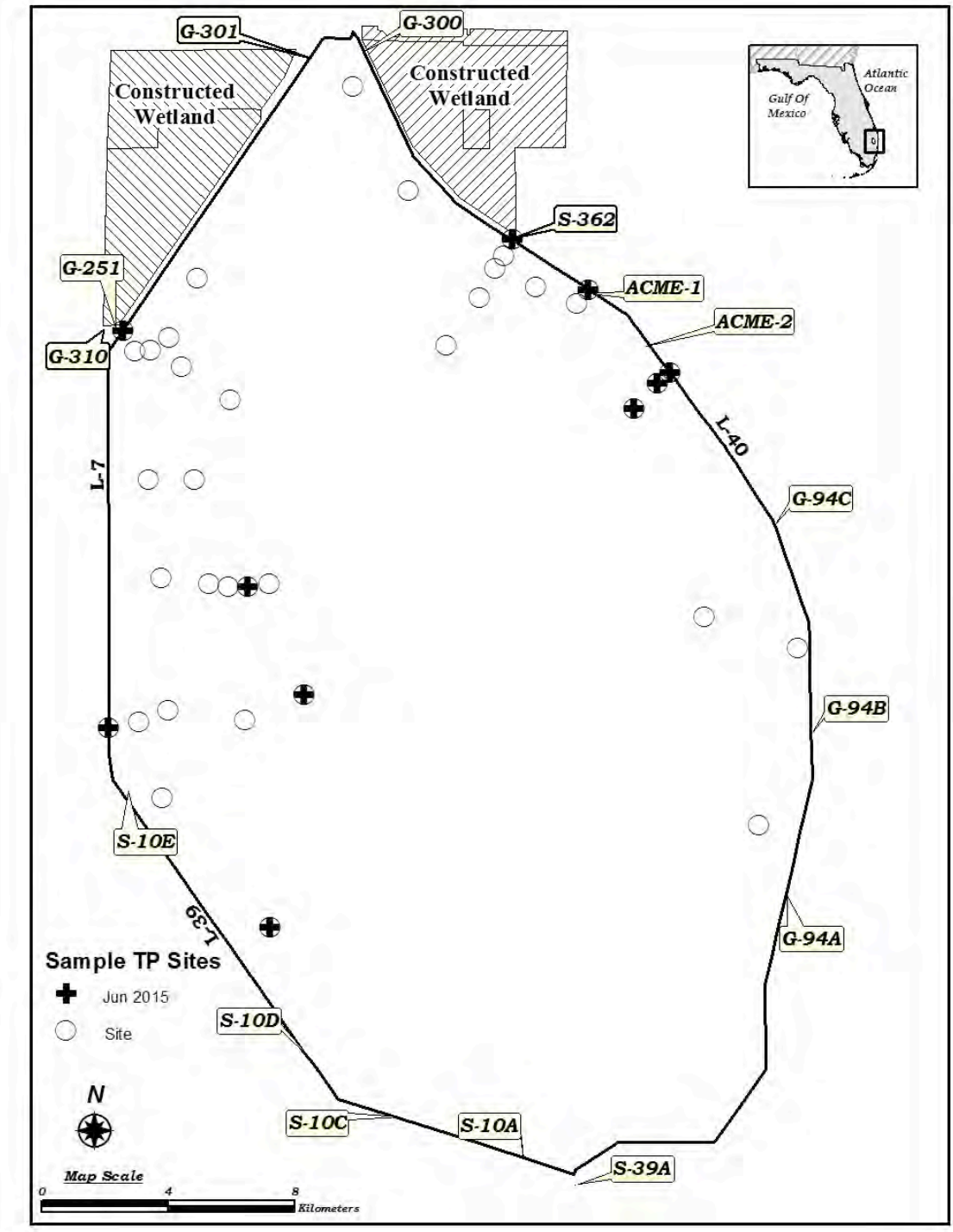

Figure 4. June 2015 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.